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## COMPLETE SPECIFICATION.

## Improvements in the Production of Alcoholic Ferments and of Fermented Liquids thereby.

I, JOKICHI TAKAMINE of 25 and 26 Honore Buildings, Chicago, State of Illinois, United States of America, Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and in and by the following statement:—

- 5 The object of my invention relates to the art of fermenting fermentable liquors and manufacturing fermented alcoholic liquors, useful in the arts for the production of alcohol, whiskey, gin, brandy, rum, wines, beer, ale, vinegar, yeast and other products from alcoholic fermentation, containing a greater percentage of alcohol than has heretofore been produced, and of any desired strength under twenty
- 10 *per cent.* of alcohol in a shorter space of time and more economically than has hitherto been done. It also relates to the preparation, development and manufacture of the diastic and fermenting properties of such *Mycelial fungi* as possess those properties or either of them.

- In the proper order of description of my invention, I first proceed to describe my
- 15 process of preparing developing and manufacturing what I shall term *Taka-Moyashi* and pure *Taka-Moyashi*.

- Tane'-Koji* (or seed koji) or *Moyashi*, is a term that has been heretofore applied to a yellowish green mouldy mass, consisting of steamed rice covered with a *Mycelial* fungus, bearing yellowish green spherical cells. This particular fungus belongs to
- 20 the class *Aspergillus*, and has the property of producing both diastase and ferment cells. It has not heretofore been designated by any specific name, and I call it "*Aspergillus Koji*."

- In preparing *Tane'-Koji* or *Moyashi* (as above defined) by the old process, hulled semi-cleaned rice is first steamed until the starch cells are opened; it is then mixed
- 25 with the ashes of trees (camelia Japonica and Kashi). The object of adding tree ashes is to supply the lack of nourishing mineral ingredients necessary to the growth of the fungus. This fertilized rice is thoroughly mixed with a proper quantity of *Tane'-Koji* or *Moyashi*, at a temperature of 20° to 30° C. and bedded up and allowed to remain for from 24 to 36 hours, when it is divided into small portions and placed
- 30 in trays and kept, under proper manipulation, temperature and humidity, until the fungus is sufficiently matured. The yellowish green mouldy substance thus obtained, is the *Tane'-Koji* of commerce. For transportation this article is simply placed in paper bags and for preservation it is kept in a cold dry place in paper bags in sealed pots.

- 35 The objections and disadvantages of the old process are as follows:—

- 1st. The composition of tree ashes supplied to the steamed rice being variable, varying even with the different parts of the same tree, a supply of the mineral ingredients in the proper quantities and proportions is not obtained;

- 2nd. Tree ashes being wholly deficient in nitrogenous ingredients, which are the
- 40 most essential for the healthy and abundant growth of the fungus, a supply of these important ingredients is, also, not obtained;

- 3rd. The substances on which *Tane'-Koji* or *Moyashi* is grown is limited to rice alone, and the only fungi employed has been limited to *Aspergillus Koji*;

- 4th. During the process of preservation and transportation, the moisture in the
- 45 article itself and in the air, and, also, the injurious microbes in the air, re-act on the starch, sugars, *etc.*, contained in the *Tane'-Koji* or *Moyashi*, and produce acid and other injurious fermentations causing the decay of the *Tane'-Koji* or *Moyashi* and make it unfit for use. Consequently the preservation for any length of time of the



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Tane'-Koji or Moyashi, or its transportation for long distances without damage was impossible.

I discovered, that other mould fungi, belonging to the class *Aspergillus*, and others included in the classification *Mucor*, *Penicillium*, and *Oryzae*, and others whose classification is not determined, possess the function of producing diastase and ferment cells, or one of these properties alone, and, therefore, I do not confine myself in this application to any particular fungus, but include all the Mycelial fungi belonging to the classes and possessing the properties above mentioned, including vinous yeast, *Torula* or *saccharomyces*.

I discovered that the mould fungi above mentioned grow and flourish in their highest stage by supplying the proper ingredients for their nourishment in the proper quantities and proportions, otherwise the mould fungi are unhealthy and less productive.

I, also, discovered that these proportions and quantities of the ingredients to be supplied vary with the different kinds of cereals or other substances employed for growing the fungi. The ingredients necessary for the healthy and abundant growth of the fungi, are :

1. Ammonium salts, such as ammonium tartarate or ammonium acetate or nitrogenous substances such as albumen or gelatine ;
2. Potassium salts, preferably potassium sulphate or potassium phosphate ;
3. Magnesium salts, preferably magnesium sulphate ;
4. Calcium salts, preferably calcium sulphate or calcium phosphate ;
5. Phosphates, preferably calcium or potassium phosphates ;
6. Alkaline carbonate, preferably potassium carbonate.

The above ingredients are mixed and combined in such proportions that in each ingredient its principal component (such as, for instance, potassium oxide  $K_2O$ —in potassium sulphate— $K_2SO_4$ —) is represented in about the following quantities :—

25 to 35 parts of potassium oxide ( $K_2O$ ) calculated from above mentioned salts ;

10 to 30 parts of calcium oxide ( $CaO$ ) calculated from above mentioned salts ;

10 to 30 parts magnesium oxide ( $MgO$ ) calculated from above mentioned salts ;

50 to 70 parts of phosphoric acid ( $P_2O_5$ ) calculated from above mentioned salts ;

2 to 10 parts of nitrogen (N) (contained in ammonium salts or nitrogenous substances) calculated from above mentioned salts or substances.

These mixtures are made slightly alkaline by potassium carbonate.

Any grain, such as rice corn wheat, barley &c., or substances which supply the necessary ingredients for the growth of the fungi such as slop (solid portion) from alcoholic distillation, pressed slop (solid portion) from beer breweries ; any bran crash or other fabric saturated with the above mentioned slop or other substances which supply the necessary ingredients for the growth of the fungi may be used for cultivating the mould fungi above mentioned, but the proportions of the ingredients in the above formula may be varied somewhat, depending upon the particular grain or other substance used. The several grains, such as rice, corn, wheat, barley, &c., and other substances, such as (solid portion) slop, bran, crash or other fabric, saturated with slop, &c., have been analysed and their chemical constituents are known and the variations in the proportion of the above formula should be made to supply a particular grain or other substance with any of the several chemical elements in which it is more or less deficient. For rice the first column of figures in the above formula set out, represents the proper proportions. Corn requires a greater proportion of phosphoric acid and ammonium salts or nitrogenous substances. The same grains may vary somewhat and the most useful and successful results depend upon the experience and observation of the operator and chemist in determining the proportions. I do not limit myself to the exact ingredients mentioned, as there are other elements which may be regarded as the chemical



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equivalents of the ingredients named, and which may perform suitably the same functions in connection with the other ingredients; such as sodium salts or lithium salts may be substituted for potassium salts, and barium and strontium salts may be used instead of calcium salts, *etc.*, *etc.* These ingredients may be dissolved in  
 5 water and sprayed over the cereals, or other substances named above, uniformly, or the cereals (either before or after being steamed) may be plunged into the solution made to a proper strength; or these ingredients may be mixed with inert substances, such as starch, *etc.*, so as to increase the volume and sprinkled uniformly over, and well mixed with, the cereals and other substances used.

10 After the cereals, *etc.*, have been impregnated with these mixtures and steamed until the starch cells are open, or until the whole mass is thoroughly sterilized (if not previously steamed sufficiently) the mass is cooled down to the temperature of 20° to 30° C., when about one fifty-thousandth part, in weight, of the cereals or other substances used, of the matured seed Mycelial fungi is added and well mixed  
 15 therewith. The mass is bedded up and allowed to remain for about six hours, when the same quantity of matured seed is added and thoroughly mixed again. After about eighteen hours more or less, the mass is divided into small portions and allowed to remain about five hours longer, when it is spread out in thin layers in a room where the temperature ranges from 20° to 30° C., and a proper degree of  
 20 humidity and fresh supply of air is secured. At the expiration of from three to six days the mass will be found to be covered with the fully matured fungus. It is then taken out of the growing room, and is ready for immediate use.

Or the mass may be dried and the matured seed may be separated from the cereals or other substances on which it is grown, and preserved in air tight vessels.  
 25 By this means a better and more uniformly matured seed of the fungi is obtained than by the old method used in making Tane'-Koji or Moyashi.

The mass thus obtained by the above described process has a mouldy appearance and will be of a color depending largely upon the cereals or other substances on which it was grown, and, also, upon the fungus employed. This matured fungus  
 30 when sown on suitable nourishing substances and developed to a certain stage acquires diastic or fermenting properties, or both, and for these properties they are valuable for use in the art of alcoholic fermentation and kindred industries.

Taka-Moyashi is dried, either by desiccating substances, such as strong sulphuric acid, or anhydrous calcium chloride, in the usual desiccating process at a tempera-  
 35 ture below 15° C., or by passing a current of dried air, below 20° C., through it. Then it is sifted through a fine sieve and the grains or other substances on which it is grown, separated from the matured seed Mycelial fungi, which is "pure Taka Moyashi" in the form of a fine powder. The powder thus prepared is again dried by the above process, and is then sealed in air tight vessels, or, it is mixed with inert  
 40 substances such as starch, or inert and at the same time hygroscopic substances, such as roasted starch or anhydrous calcium sulphate.

The objects in mixing these ingredients are two fold; (1) To increase the volume so as to be convenient for sprinkling the cereals or other substances in Koji making. (2) To keep the matured seed Mycelial fungi dry, to prevent any  
 45 possibility of a change from a dormant state to a state of activity; or the powder when kept in sealed vessels may be surrounded by the above mentioned hygroscopic substances to prevent any possibility of absorbing moisture.

The matured seed in the mass thus prepared I call generically "Taka-Moyashi" to distinguish it from the ordinary Moyashi or Tane'-Koji, and when separated  
 50 from the mass I call it generically "pure Taka Moyashi."

I now proceed to describe my process of preparing and developing and making Taka Koji.

In the old process of Koji making, rice is steeped in water and steamed until the starch cells are opened, when it is cooled down to a temperature of about 30° C.,  
 55 and about one two-thousandth part, in weight, of the rice employed, of the Tane'-Koji is added and thoroughly mixed with the steamed rice. The mass is bedded



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up and allowed to remain for about six hours when the same amount of Tane'-Koji or Moyashi is added as before. At the expiration of about twenty hours, the mass is divided into small portions and placed in trays and kept under proper manipulation, temperature and humidity until the fungus growth is sufficiently matured; it is then taken out of the growing room and kept in a cool place ready 5 for use.

Koji thus prepared has an opaque white mouldy appearance, and possesses diastatic properties and contains ferment cells.

The defects of the old process of making Koji, which I remedy by my invention are as follows; viz. :— 10

1st. The grains used in making Koji in the alcoholic industries have been limited to rice alone, although the term Koji has been applied to wheat and beans prepared as an article of food;

2nd. The whole unbroken grains are employed;

3rd. The only fungus used is the particular species *Aspergillus Koji*, 15 Takamine;

4th. The making of the Koji is completed when the fungus growth is sufficiently advanced and the finished Koji consisting of the fungus and the substance on which it was grown, is used in the mass in this finished condition, both as a diastase for the conversion of starch into sugar, and, also, as a ferment 20 in changing the sugars into alcohol. As a consequence when the conversion is carried on under a high temperature, the ferment cells are killed and wasted; and, on the other hand, in the process of fermentation, the diastatic properties of the Koji are of no value, and are also wasted. The finished Koji thus described is kept in small trays in thin layers for preservation; and its preservation in bulk or 25 in large masses is impossible owing to the fact that the moisture it contains generates heat, causing the decay of the product.

In my process of making Taka-Koji, I do not limit myself to the above named cereals, but employ in addition to these corn, oats, barley, and all other cereals and, also, other substances which supply the ingredients necessary to the growth of the 30 fungi, such as pressed slop (solid portion of) from alcoholic distillations, grain from beer brewing; the residue from seed oil, beet root sugar, glucose and starch factories, and other artificial mixtures such as bran, crash or other fabric, saturated with any of the above slops or thin paste of gelatinized starch obtained from corn wheat or other cereals or starch containing or nutritious substances. I secure by 35 this process cheaper and more efficient substances in which to grow fungi for diastatic and fermenting purposes.

The cereals and other substances employed are broken and comminuted, whereby the surface on which the fungi grow is largely increased, and consequently a more abundant growth of the fungi is secured, and the diastatic and fermenting properties 40 of the Taka-Koji are of superior strength and are produced more economically.

I use such species of *Aspergillus* (including *Aspergillus Koji*), *Mucor*, *Oryzae* and *Penicillium* and other fungi as produce diastase and ferment cells or either of these products alone.

In my process Taka-Koji may be used in a condition corresponding to the 45 condition in which Koji is used as above described, both as a diastase and a ferment at the same time; or, after the fungi are sufficiently grown the mass consisting of the fungi and the substance on which they were grown may be thoroughly dried and the fungi containing the ferment cells separated by sifting washing or otherwise 50 from the cereals or other substances employed, which cereals or other substances employed contain the diastatic properties of the Taka-Koji. The two parts, the one containing the ferment, and the other the cereals or other substances, containing the diastatic properties of the Taka-Koji may be used separately, the part containing the diastase for converting the starch into sugar; and the part containing the 55 ferment cells for the fermentation or changing the sugar into alcohol. By means of this division and separation I utilize fully, without any waste both the diastatic



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and fermenting properties of the Taka-Koji and employ but about one-half the quantity of Taka-Koji with better results in conversion and fermentation, than is required where Koji is employed in an unseparated condition as above described.

5 Taka-Koji is dried by artificial means whereby it can be preserved for an indefinite period in bulk and without spreading into thin layers, securing by this means great economy of space and materials.

The cereals and other substances containing the necessary ingredients for the growth of the fungi are employed in a broken or comminuted form in order to increase the surface on which the fungi grow to their highest state of efficiency.  
10 The cereals or other substances are steamed, or heated, in the case of cereals until the starch cells are opened, and in the case of the other substances until they are thoroughly (if not already) sterilized. The cereals employed in making Taka-Koji are corn, rice, wheat, barley, oats and any other cereals supplying the necessary ingredients for the growth of the fungi; and the other substances employed are  
15 pressed slop (solids) from alcoholic distillations—slop or grain (solids) from beer brewing, refuse and waste from glucose, starch, beet root sugar and seed oil factories, or any bran, crash or other fabric, saturated with any of the above mentioned slop (liquid or solid or both combined) or nutritious substances, such as thin paste of gelatinized starch obtained from corn wheat or other cereals  
20 or starch containing substances and all other substances whether in their natural state or artificially treated which possess the necessary ingredients for the growth of the fungi.

After being thoroughly steamed as before described the mass is allowed to cool down to a temperature below 30° C., when about one fifty-thousandth part in  
25 weight of the cereals or other substances employed, of the pure Taka-Moyashi, or about one one-thousandth part, in weight, of the mass of cereals or other substances employed, of the Taka-Moyashi, or Tane'-Koji is added to and thoroughly mixed with the mass of cereals or other substances employed, and the entire mass of cereals or other substances is then bedded up and allowed to remain in a temperature not exceeding 40° C., for six hours, when with or without the addition of  
30 more Taka-Moyashi, or Tane'-Koji, the mass is again mixed and bedded up. At the expiration of about eighteen hours, the mass is divided into small portions and allowed to remain for about five hours longer, when it is spread into thin layers, by suitable arrangements or apparatus and kept in a moist atmosphere under a temperature not to exceed 50° C., for a period varying from 20 to 60 hours. When  
35 the highest point of utility of the Taka-Koji as a diastase and ferment is attained (indicated by the appearance of the fungus growth) the mass is cooled down to a temperature not exceeding 20° C. The mass thus obtained is Taka-Koji made by my process and is ready for immediate use.

40 Or the mass after Taka-Moyashi or Tane'-Koji, (or Moyashi) has been added and bedded up for from ten to eighteen hours may be spread out on a preferably cemented floor, such as is now used for growing and developing malt and thinned out gradually by turning and spreading every two to four hours as the temperature rises, until it reaches a thickness of from two to four inches. During a process of  
45 spreading and thinning out which is continued for from twenty to sixty hours, care must be taken that the temperature of the mass does not rise much above 40° C., and, also, that the air of the room be kept sufficiently moist. At the expiration of about sixty hours, the fungus growth will be found to be sufficiently developed for the purpose for which the Taka-Koji is made and it will be ready for  
50 immediate use.

Taka-Koji presents in this form a mouldy appearance its color depending largely on the cereals and other substances used, and, also, on the species of the fungi employed. It possesses both diastie and fermenting properties or either of these properties alone, the diastie properties residing in the cereals or other  
55 substance employed and the fermenting properties are due to ferment cells grown on the fungus plant. When the diastie and fermenting properties are



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both profitably utilized at the same time, the Taka-Koji may be used in its condition as described.

For the preservation solely of Taka-Koji it is thoroughly dried under a temperature not exceeding 50° C. and kept in a mass in a dry place at a temperature not exceeding 50° C.

Where Taka-Koji is used for conversions made at a temperature exceeding 60° C., or where the fermenting power alone of the Taka-Koji is utilized, the dry Taka-Koji is separated either by sifting through a sieve or otherwise into two parts,—one containing in the form of a fine dry powder the fungus or ferment cells, containing the fermenting properties and the other part, the cereals or other substances employed, which contain the diastatic properties of the Taka-Koji; these two resulting products, the one the seed of fungus or ferment cells, the other the diastase containing substances, are used separately and independently of each other; the seed of the fungus or the ferment cells for the purposes of fermentation and the diastase containing substance for purposes of converting starch into sugars. Or the diastatic and fermenting properties of the Taka-Koji may be separated from the substance on which it grows by soaking the Taka-Koji in water and stirring and pressing, whereby the diastase will dissolve in the water and the ferment cells will become detached and remain suspended in the liquid. This process of steeping in water and pressing is repeated as often as required. The liquid thus produced will contain the diastase of the Taka-Koji in solution and the ferment cells held in suspension. These are separated the one from the other by filtration.

When the separation of the diastatic properties of the Taka-Koji alone is desired, the Taka-Koji is steeped in water and pressed through a filter, the clear solution thus obtained contains the diastase alone.

I now describe my process of preparing developing and making Moto.

The term Moto is applied to a liquor containing active ferment cells which have been metamorphized from aerobic ferment cells grown on the Mycelial fungi (Koji or Taka-Koji) to anaerobic ferment cells, and by the process of germination, have developed and multiplied into an active state in sugar solution. Moto corresponds to the article known as yeast in its use in the arts, such as alcoholic fermentation, bread making &c., etc.

In the old process of making Moto, six parts of clean steamed rice, with two and one-half parts of rice-koji, and seven and one-half parts of water are mixed together, and the mixture exposed to the air with occasional stirrings at the natural winter temperature varying from 0 to 15° C. for five or six days; during this time granulation of the grain and absorption of oxygen from the air takes place. After this period the temperature of the mixture is raised by placing in it a tub containing water heated to nearly the boiling point and it is kept at a temperature varying from 15° to 30° C. for from four to six days. During the early part of this state, conversion of the starch into sugars begins and proceeds increasingly, and the multiplication of the ferment cells, and alcoholic fermentation goes on at the same time; at the latter end of this period the taste of sugar disappears and the taste of alcohol takes its place, when the Moto is considered to be finished and ready for use.

The defects of the old process as described, are :—

1st. The only substance known which could supply the necessary ingredients for any practical growth of the ferment cells was rice, and no process or treatment was known by which other, natural or artificial, substances containing such necessary ingredients, could be employed.

2nd. The conversion of the starch into sugars by the diastase contained in the Koji being made at a low temperature a complete conversion is not attained; in some instances as much as 16% of the finished Moto, consisting of unconverted starch. The presence of this unconverted starch caused acid fermentation, both in the Moto and in the subsequent fermentation of the mash.



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3rd. The temperature of the mixture is not uniform or regular, by reason of the crude and imperfect method employed in heating it; consequently the development of the ferment cells is irregular and imperfect, and the Moto is from this cause, also, subject to injurious fermentation.

5 4th. The entire process being very slow, the Moto is exposed for a great length of time to injurious bacteria in the surrounding air.

5th. The grain of the rice and of the Koji is employed in an unbroken state and the only means of crushing the grains being the stirrings to which the mixture is subjected, much of the starch in the grains is not released and remains from this  
10 cause unconverted into sugars; resulting not only in a waste of material, but in an injury to the quality of the Moto.

In my process of making Moto, any of the cereals or starch containing substances or substances which supply the necessary ingredients for the growth of the ferment cells, may be employed. These cereals or starch containing substances, *etc.*, are  
15 first ground to a fine meal, to which about twice their own weight of water is added and in which they are thoroughly cooked, preferably at about a temperature of 150° C. under pressure, so that all the starch cells are opened and gelatinized; it is then cooled down to a temperature of from 60 to 75° C. To this mass is added from 3 to 20% in weight of the cereals or other substances used, of  
20 Taka-Koji, either ground or unground, or of the diastatic portion of the Taka-Koji alone, either in a solid or a liquid form, or of ordinary Koji, either ground or unground, and well stirred and kept at the above temperature for about one hour, during which period the thorough and complete conversion of the starch in the mass into sugars is made. It is then allowed to cool down slowly being constantly  
25 agitated by stirring whereby the solution or mash absorbs the proper amount of oxygen from the air, the stirring continues until the temperature is reduced to about 19° C., at the expiration of from 5 to 20 hours there is added to the solution or mash about the same amount that was used before of the Taka-Koji, either ground or unground, or of the ferment portion alone of the Taka-Koji, either in  
30 solid or liquid form or of Koji. The solution or mash is then allowed to remain while the development and multiplication of the ferment cells, and the process of fermentation goes on, care being taken to keep the temperature of the solution or mass at this time below about 30° C.—which is conveniently accomplished by the use of a tub fitted inside with a coil through which hot and cold water can be  
35 passed at will. When the maximum point in the development and multiplication of the ferment cells is reached, which is generally indicated by the change in the taste of the solution or mash from a sweet to an alcoholic flavor, the solution or mass is preferably cooled down to a temperature of from 15 to 20° C., and the Moto as made by my process is ready for use.

40 The ferment cells contained in Moto are developed and multiplied in a sugar solution from the Taka-Koji or from the ferment portion of the Taka-Koji. This sugar solution may be produced by the conversion of gelatinized starch into sugars by means of the diastase of the Taka-Koji, or of malt; or it may be any other sugar solution or, furthermore, it may consist of any mixture containing the  
45 necessary ingredients for the development and multiplication of the ferment cells.

Moto, as made by my process, may be perpetuated or reproduced by transplanting Moto previously made as above described to any sugar solution, made as above described, or to any solution containing the ingredients necessary for the development of and multiplication of the ferment cells.

50 The Moto prepared by my process requires the employment of a much less quantity of grain; it is produced in much less time and with greater certainty as to results; it contains about three times greater a number of ferment cells to a given weight, and the fermenting power of the ferment cells is increased. The Moto is consequently more efficient and active as a ferment and it can be preserved and  
55 utilized much longer than Moto made by the old process.

I shall now proceed to describe my process of fermenting alcoholic liquors:

In the production of alcoholic liquors from cereals or other starch-containing



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substances, by any known process, the first step is the conversion of the starch in the cereals &c., into soluble sugars by means of an agent known as diastase. The second and remaining step in the process of producing fermented alcoholic liquors is the dissociation of the soluble sugar into alcohol and carbonic acid gas by the agency of the ferment cells.

In the pursuit of alcoholic industries in the American and European countries, the conversion of starch contained in the cereals and other substances employed, into sugars, is effected by means of the diastase contained in the malts. Diastase obtained from malt is very expensive, not only because it is made from the highest priced grain and because of the cost and labour of malting them, but, also, by reason of the great loss of starch in the grain, which occurs in the malting process and diminishes the yield of alcohol. The change of the sugar thus obtained, into alcohol, is effected by means of Vini-yeast (*Saccharomyces Cerevisiae*) which is incapable of developing and multiplying in solution containing more than six or seven per cent. of alcohol and, is therefore unable to ferment a liquor of more than six or seven per cent. of alcoholic strength.

In the pursuit of alcoholic industries in other countries of the world (Oriental) the conversion of starch contained in the grain employed is effected by means of a diastase produced by the growth of a species of mould fungi (*Aspergillus-Koji* "Takamine") on rice. As this conversion is made at a low temperature, a complete change of the starch into sugars is impossible and a great length of time is required exposing the solution to danger from injurious ferments in the surrounding air.

The process of fermentation is effected by the agency of aerobiotic ferment cells, grown on the above fungus and metamorphized into anaerobiotic ferment cells, which change the sugars in the solution into alcohol. The above mentioned conversion and fermentation being carried on at the same time, or simultaneously, the process of fermentation is slow and occupies a great length of time, which also subjects the solution to danger from injurious ferments in the surrounding air; the incomplete conversion above mentioned of the starch into sugars not only results in the waste of material, but causes acetic fermentation, which consumes the alcohol produced and diminishes the yield.

In my process of making fermented alcoholic liquors I employ any of the cereals or starch containing ingredients or substances which supply the necessary ingredients for the alcoholic fermentation. These cereals or starch containing substances *etc.*, are first ground to a fine meal which is thoroughly cooked with from one half to five times the weight of cereals &c., of water, preferably at a temperature of 155° C. under pressure so that all the starch cells are open and gelatinized. The mass is then cooled down to a temperature of from 65° to 70° C.

To this mass of cereals or other substances used thus cooked is added 3 to 20 % in weight of Taka-Koji, either ground or unground, or of the diastatic portion of the Taka-Koji alone either solid or liquid in form, or of the ordinary Koji, either ground or unground, and well stirred, and kept at the above temperature for about one hour, during which period the thorough and complete conversion of the starch contained in the cereals and other substances used into sugars is made. It is then cooled down to about 19° C.

The sugar solution thus prepared is of such strength or composition that the sugars contained in it when converted into alcohol produce the desired strength of alcohol.

To the sugar solution thus obtained or to any other sugar solution obtained in any other way, such as glucose solution, malt extract, inverted cane sugar solution; syrup or molasses solution *etc.*, from 2 to 10 % of Moto or a mixture of Moto and yeast or yeast is added, and the process of fermentation or the dissociation of the sugars contained in the solution into alcohol and carbonic acid gas by the agency of the ferment cells contained in the Moto, or mixture of Moto and yeast, goes on until all the sugars in the solution are dissociated.

As the process of fermentation goes on any other sugars or sugar solution may be added to the mash all at once or fractionally. The object of adding the



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fermentable sugars fractionally is to keep the mash in a suitable strength of sugars so that the fermentation is not retarded by the presence of too much sugar in the mash at one time.

Usual and due precaution is exercised during the process of fermentation.

5 The time required to complete fermentation depends largely upon the strength of the sugar solution. Where the solution is of the same or equal strength as the solution in which yeast alone is employed, the fermentation is much superior and occupies less time, owing to the superior character of the ferment cells contained in the Moto.

10 The percentage of alcohol contained in the fermented liquor produced by the fermentation, is proportionate to the strength of the sugar solution or sugars used.

Alcoholic liquors fermented by ordinary yeast contain from but six to seven *per cent.* of alcohol, owing to the inability of the yeast cells to live and work in a solution containing more than six or seven *per cent.* of alcohol; therefore in order to  
15 obtain six or seven parts of alcohol, one hundred parts of the fermented liquor have to be dealt with throughout the entire process.

By my process a fermented liquor containing about 20 % of alcohol is made, owing to the ability of the ferment cells in the Moto increased in ferment power and number by my process of preparing it, to live and work in a solution containing  
20 20 % of alcohol when fermented; or a fermented liquor containing any desired strength of alcohol under 20 % can be produced; therefore in order to get the same quantity of alcohol, as before, I have to deal with only about one-third part of the liquor. Thus the cost of labour and fuel, the amount of capital and the size of the plant are reduced to one third or thereabouts or a given sized plant can  
25 produce three times as much alcohol as by the old process where yeast is employed, with the same or nearly the same working expenses.

If the object of the fermentation is for strong or distilled alcoholic liquors, such as whiskey, rum, gin, *etc.*, the fermented liquor is subjected to the process of distillation. When the fermentation is for weaker beverages, such as beer, ale,  
30 porter *etc.*, the fermented liquor is previously treated to suit its respective object, such as boiling with hops, or scorching of grain and afterwards diluting with water to its desired alcoholic strength, and then charged with air or carbonic acid gas if required.

Having now particularly described and ascertained the nature of my said  
35 invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. The process of growing, preparing and developing a fungus possessing diastic and fermenting properties or either of said properties which consists (1) in impregnating or saturating the natural grain or other substances employed with an  
40 artificial supply of proper food for the growth of the fungus, composed as follows:—

1. Ammonium salts, such as ammonium tartarate or ammonium acetate, or nitrogenous substances such as albumen or gelatine;
2. Potassium salts, preferably potassium sulphate or potassium phosphate;
- 45 3. Magnesium salts, preferably magnesium sulphate;
4. Calcium salts, preferably calcium sulphate or calcium phosphate;
5. Phosphates, preferably calcium or potassium phosphates;
6. Alkaline carbonate, preferably potassium carbonate;

in the proportions specified; (2) Steaming said rice or other substances either  
50 before or after the impregnation or saturation as above; (3) Sowing or planting the seed of said fungus upon the grain or other substances thus impregnated or saturated; (4) Subjecting said mass thus prepared and treated to a proper and even temperature and to manipulation for the growth and development of the fungus until the same has reached its maturity; substantially as and for the  
55 purpose set forth.

2. The process of preserving the matured seed of a fungus possessing diastic and



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fermenting properties or either of said properties, which consists in thoroughly drying the mass (Taka-Moyashi); separating the matured seed therefrom by any means, such as sifting, again drying the seed; mixing said seed with an inert or with an inert and hygroscopic substance and sealing in air tight vessels; substantially as and for the purpose set forth.

3. As an article of commerce, the seed of a fungus possessing the properties of producing diastatic and fermenting properties or either of said properties, when sown on suitable nourishing substances in the form of a dry yellowish green powder containing dormant vital ferment cells, substantially as and for the purpose set forth.

4. As an article of commerce, Taka-Moyashi in the form of a mass of comminuted grain or other substance that has been impregnated or saturated with:

1. Ammonium salts, such as ammonium tartarate ammonium acetate or nitrogenous substances such as albumen or gelatine;
2. Potassium salts, preferably potassium sulphate or potassium phosphate;
3. Magnesium salts, preferably magnesium sulphate;
4. Calcium salts, preferably calcium sulphate or calcium phosphate;
5. Phosphates, preferably calcium or potassium phosphates;
6. Alkaline carbonate, preferably potassium carbonate, in the proportions specified and which is thoroughly permeated with a growth of the matured fungus containing diastatic and fermenting properties, or either of said properties; substantially as and for the purpose set forth.

5. The herein described composition of matter to be used for fertilizing the cereals and other substances, upon which Mycelial Fungi (Mould Fungi or Hyphomycetes Fungi) having the properties of producing diastase and ferment cells, or either of these properties alone, is grown and developed, consisting of:

1. Ammonium salts, such as ammonium tartarate ammonium acetate, or nitrogenous substances such as albumen or gelatine;
2. Potassium salts, preferably potassium sulphate or potassium phosphate;
3. Magnesium salts, preferably magnesium sulphate;
4. Calcium salts, preferably calcium sulphate or calcium phosphate;
5. Phosphates, preferably calcium or potassium phosphates;
6. Alkaline carbonate, preferably potassium carbonate; in substantially the proportions specified.

6. The process of preparing and making Taka-Koji which consists in providing a mass of broken and comminuted grain or starch containing substances, or substances possessing the necessary ingredients for the growth of the fungus; steaming and heating the mass until the starchy matter present is gelatinized or the mass sterilized (unless the material employed in the mass has been previously sterilized) adding to the mass in proportion to the weight about one fifty-thousandth part in weight of the pure Taka-Moyashi or one thousandth part of the Taka-Moyashi or Tane'-Koji, mixing the same thoroughly and subjecting the mass to the temperature and manipulations until the fungus properly develops and is cooled; substantially as shewn.

7. The process of preparing and making Taka-Koji which consists in providing a mass of broken and comminuted grain, or starch-containing substances, and substances possessing the necessary ingredients for the growth of the fungus; steaming and heating the mass until the starchy matter present has been gelatinized and the mass sterilized; adding to the mass in proportion to its weight about one fifty-thousandth part in weight of pure Taka-Moyashi, or one one-thousandth part in weight of Taka-Moyashi or Tane'-Koji, thoroughly mixing the entire mass and bedding up the same in a temperature not exceeding 40° C., after six hours again thoroughly mixing and bedding up the mass; at the expiration of about ten to eighteen hours, during which the temperature should not be permitted to rise above 40° C., which is done by frequent turnings of the mass; dividing the mass into small portions in which condition it remains for about five hours when it is



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spread out into thin layers in a temperature not to exceed 40° C., for from 20 to 60 hours, until the fungus develops to a proper stage, then cooling down the mass to a temperature not exceeding 20° C., all substantially as shewn.

8. The process of preparing and making Taka-Koji which consists in providing  
 5 a mass of broken and comminuted grain or starch-containing substances or substances containing the necessary ingredients for the growth of the fungus, steaming and heating the mass until the starchy matter present is gelatinized and the mass sterilized; adding to the mass in proportion to its weight about one fifty-thousandth part in weight of pure Taka-Moyashi or one one-thousandth part in  
 10 weight of Taka-Moyashi or Tane'-Koji, thoroughly mixing the entire mass and bedding up the same in a temperature not exceeding 40° C., after six hours again thoroughly mixing and bedding up the mass; at the expiration of about 10 to eighteen hours spreading the mass on a preferably cemented floor such as is used in growing malt turning the mass over every two to four hours and gradually thinning  
 15 it out until it reaches a thickness of about two to four inches, taking care not to permit the temperature of the mass to rise above 40° C., and continuing this turning and thinning for from 20 to 60 hours until the fungus grows to a proper stage, all substantially as described.

9. The process of preparing and making Taka-Koji which consists in providing  
 20 a mass of broken and comminuted grain or starch-containing substances, or substances possessing the necessary ingredients for the growth of the fungus; steaming and heating the mass until the starchy matter present is gelatinized and the mass sterilized (unless the material employed in the mass has been previously gelatinized or sterilized) adding to the mass in proportion to its weight  
 25 about one fifty-thousandth part in weight of pure Taka-Moyashi, or one one-thousandth part in weight of Taka-Moyashi or Tane'-Koji, thoroughly mixing the entire mass, and subjecting it to the temperatures and manipulations until the fungus develops to its proper stage and is cooled down; then separating the seed or ferment cells of the fungus from the mass, or separating the ferment cells and  
 30 diastase from the mass together, or separating the diastase and ferment cells from each other by filtration all substantially as shewn.

10. As an article of commerce Taka-Koji consisting of a mass of broken and comminuted grain or starchy matter or other substances possessing the necessary ingredients for the growth of the fungus having diastatic or fermenting properties or  
 35 both of these properties; the starchy matter if any present gelatinized and the mass sterilized; said mass being covered and permeated with the growth of said fungus or fungi growing upon and adhering to the surfaces of the comminuted particles of said mass; all substantially as shown.

11. As an article of commerce Taka-Koji consisting of a mass of broken and comminuted grain or starchy matter or other substances possessing the necessary ingredients for the growth of a fungus having diastatic or ferment properties, or both  
 40 of said properties; the starchy matter, if any present, gelatinized and the mass sterilized; said mass being permeated with the diastase from the growth of the fungus the seeds thereof being removed therefrom all substantially as shown.

12. As an article of commerce, Taka-Koji a fine dry powder composed of the seeds or spores possessing fermenting power of fungi possessing diastatic or fermenting properties or both of said properties, being the product of said fungi grown  
 45 upon cereals starchy matter or other substances possessing the necessary ingredients for their growth; all substantially as described.

13. The process of preparing and making Moto which consists in adding to and mixing with any fermentable solution in the proportion of one hundred parts of sugar and twenty parts of Taka-Koji or five parts of the ferment portion of Taka-Koji and keeping the same at a temperature below 30° C., until the fermentation  
 50 has changed the flavor of the mixture to an alcoholic taste and the development and multiplication of the ferment cells have been effected all substantially as described.

14. The process of preparing and making Moto which consists in (1) adding to



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a mash of cereals, starch containing substances, or other substances capable of conversion into sugars, cooked in about twice their own weight of water under pressure until the starch cells are opened and gelatinized and then cooled down to about from 60° or 70° C. from five *per centum* to 20 *per centum* in weight of the cereals &c., of Taka-Koji either ground or unground, or of the diastatic portion of the Taka-Koji alone either in a solid or liquid state, or of the ordinary Koji, ground or unground, and then thoroughly stirring the same for about one hour and until there is a thorough and complete conversion of starch into sugars; (2) continuing the agitation by stirring until the temperature of the mass is reduced to about 19° C., then adding thereto about the same proportion of Taka-Koji or ordinary Koji, ground or unground, or of the ferment portion of the Taka-Koji in solid or liquid state, that was previously added, then allowing the mass to stand at a proper temperature until the flavor of the mass acquired an alcoholic taste and the development and multiplication of the ferment cells are effected; all substantially as described.

15. The process of preparing and making Moto which consists in (1) treating a mash of ground cereals starch containing materials or other substances capable of conversion into sugars, cooked until the matter capable of being converted into sugars has been gelatinized adding to the mass at a temperature of from 65 to 70° C., from five to twenty *per centum* in weight of the cooked mass, of Taka-Koji, ground or unground; or of the diastatic portion of the Taka-Koji in a solid or liquid state, or of ordinary Koji ground or unground; then stirring the mass for about one hour and until there is a thorough conversion of the starchy matter present into sugars (2) continuing the agitation by stirring until the temperature is reduced to about 19° C., then again adding about the same proportion of Taka-Koji, or Koji ground or unground, in a solid or liquid form that was first added; then allowing the mass to stand at a proper temperature until the fermentation gives the mass an alcoholic flavor and the development and multiplication of the ferment cells are effected; all substantially as described.

16. As an article of commerce, Moto—a liquid or thin paste composed principally of water and alcohol with some slight residuum or traces of gelatinized starch sugars and fibre, and containing fully and uniformly throughout its mass the active ferment cells possessing ferment properties or both ferment and diastatic properties, all substantially as described.

17. As an article of commerce, Moto, a liquid or thin paste composed principally of water and alcohol with some slight residuum or traces of gelatinized starch sugars and fibre; and containing throughout its mass the active ferment cells first grown on aerobic fungi and other substances containing the required nutriment, and, secondly, developed and multiplied as anaerobic ferment cells in sugar solutions; all substantially as described.

18. The process of making a fermentable wash or liquor which consists in adding to the mass or material to be converted in the proportions specified, the diastatic portion of the Taka-Koji or of the ordinary Koji, at the temperature specified and agitating the same, whereby the convertible material present is converted into sugar, substantially as described.

19. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor by adding thereto in the proportions specified, Moto or Moto and yeast, or yeast whereby the fermentable material present is dissociated into alcohol and gas; all substantially as described.

20. The process of making a fermented liquor which consists in adding a fermentable wash or liquor prepared by the introduction in the proportions specified of Taka-Koji or the diastatic portion of the Taka-Koji or of Koji to a ferment containing wash or liquor prepared by the introduction in the proportions specified of Moto or Moto and yeast, or yeast said addition being made fractionally as the fermentation proceeds in order to keep the solution at the desired strength, whereby the fermentable material present is dissociated into alcohol and gas; all substantially as described.



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21. The process of making alcoholic liquor which consists in fermenting a fermentable wash or liquor by the introduction of Moto or Moto and yeast or yeast in the proportions specified and distilling the product; all substantially as described.

5 22. The process of making a fermented liquor which consists in adding a fermentable wash or liquor prepared by the introduction in the proportions specified of Taka-Koji or of the diastic portion of the Taka-Koji or of Tane'-Koji, to a ferment containing wash or liquor prepared by the introduction in the proportions specified of Moto or Moto and yeast or yeast said addition being made fractionally as the fermentation proceeds in order to keep the solution at the desired strength whereby the fermentable material present is dissociated into alcohol and gas, and distilling the products; all substantially as described.

10 23. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor that has been treated by the introduction of hops, scorched grain or similar material by adding thereto in the proportions specified Moto or Moto and yeast or yeast and then diluting the same to the required alcoholic strength; all substantially as described.

Dated this 12th day of October 1891.

JOKICHI TAKAMINE,  
By L. W., per F. B.

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N° 17,374



A.D. 1891

Date of Application, 12th Oct., 1891—Accepted, 12th Oct., 1892

## COMPLETE SPECIFICATION.

## Improvements in the Production of Alcoholic Ferments and of Fermented Liquids thereby.

I, JOKICHI TAKAMINE of 25 and 26 Honore Buildings, Chicago, State of Illinois, United States of America, Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and in and by the following statement:—

- 5 The object of my invention relates to the art of fermenting fermentable liquors and manufacturing fermented alcoholic liquors, useful in the arts for the production of alcohol, whiskey, gin, brandy, rum, wines, beer, ale, vinegar, yeast and other products from alcoholic fermentation, containing a greater percentage of alcohol than has heretofore been produced, and of any desired strength under twenty
- 10 per cent. of alcohol in a shorter space of time and more economically than has hitherto been done. It also relates to the preparation, development and manufacture of the diastic and fermenting properties of such Mycelial fungi as possess those properties or either of them.

- In the proper order of description of my invention, I first proceed to describe my
- 15 process of preparing developing and manufacturing what I shall term Taka-Moyashi and pure Taka-Moyashi.

- Tane'-Koji (or seed koji) or Moyashi, is a term that has been heretofore applied to a yellowish green mouldy mass, consisting of steamed rice covered with a Mycelial fungus, bearing yellowish green spherical cells. This particular fungus belongs to
- 20 the class *Aspergillus*, and has the property of producing both diastase and ferment cells. It has not heretofore been designated by any specific name, and I call it "Aspergillus Koji."

- In preparing Tane'-Koji or Moyashi (as above defined) by the old process, hulled semi-cleaned rice is first steamed until the starch cells are opened; it is then mixed
- 25 with the ashes of trees (camelia Japonica and Kashi). The object of adding tree ashes is to supply the lack of nourishing mineral ingredients necessary to the growth of the fungus. This fertilized rice is thoroughly mixed with a proper quantity of Tane'-Koji or Moyashi, at a temperature of 20° to 30° C. and bedded up and allowed to remain for from 24 to 36 hours, when it is divided into small portions and placed
- 30 in trays and kept, under proper manipulation, temperature and humidity, until the fungus is sufficiently matured. The yellowish green mouldy substance thus obtained, is the Tane'-Koji of commerce. For transportation this article is simply placed in paper bags and for preservation it is kept in a cold dry place in paper bags in sealed pots.

- 35 The objections and disadvantages of the old process are as follows:—

1st. The composition of tree ashes supplied to the steamed rice being variable, varying even with the different parts of the same tree, a supply of the mineral ingredients in the proper quantities and proportions is not obtained;

- 2nd. Tree ashes being wholly deficient in nitrogenous ingredients, which are the
- 40 most essential for the healthy and abundant growth of the fungus, a supply of these important ingredients is, also, not obtained;

3rd. The substances on which Tane'-Koji or Moyashi is grown is limited to rice alone, and the only fungi employed has been limited to *Aspergillus Koji*;

- 4th. During the process of preservation and transportation, the moisture in the
- 45 article itself and in the air, and, also, the injurious microbes in the air, re-act on the starch, sugars, etc., contained in the Tane'-Koji or Moyashi, and produce acid and other injurious fermentations causing the decay of the Tane'-Koji or Moyashi and make it unfit for use. Consequently the preservation for any length of time of the

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Tane'-Koji or Moyashi, or its transportation for long distances without damage was impossible.

I discovered, that other mould fungi, belonging to the class *Aspergillus*, and others included in the classification *Mucor*, *Penicillium*, and *Oryzae*, and others whose classification is not determined, possess the function of producing diastase 5 and ferment cells, or one of these properties alone, and, therefore, I do not confine myself in this application to any particular fungus, but include all the Mycelial fungi belonging to the classes and possessing the properties above mentioned, including vinous yeast, *Torula* or *saccharomyces*.

I discovered that the mould fungi above mentioned grow and flourish in their 10 highest stage by supplying the proper ingredients for their nourishment in the proper quantities and proportions, otherwise the mould fungi are unhealthy and less productive.

I, also, discovered that these proportions and quantities of the ingredients to be supplied vary with the different kinds of cereals or other substances employed for 15 growing the fungi. The ingredients necessary for the healthy and abundant growth of the fungi, are:

1. Ammonium salts, such as ammonium tartarate or ammonium acetate or nitrogenous substances such as albumen or gelatine;
2. Potassium salts, preferably potassium sulphate or potassium phosphate; 20
3. Magnesium salts, preferably magnesium sulphate;
4. Calcium salts, preferably calcium sulphate or calcium phosphate;
5. Phosphates, preferably calcium or potassium phosphates;
6. Alkaline carbonate, preferably potassium carbonate.

The above ingredients are mixed and combined in such proportions that in each 25 ingredient its principal component (such as, for instance, potassium oxide  $K_2O$ —in potassium sulphate— $K_2SO_4$ —) is represented in about the following quantities:—

- 25 to 35 parts of potassium oxide ( $K_2O$ ) calculated from above mentioned salts;
- 10 to 30 parts of calcium oxide ( $CaO$ ) calculated from above mentioned 30 salts;
- 10 to 30 parts magnesium oxide ( $MgO$ ) calculated from above mentioned salts;
- 50 to 70 parts of phosphoric acid ( $P_2O_5$ ) calculated from above mentioned 35 salts;
- 2 to 10 parts of nitrogen ( $N$ ) (contained in ammonium salts or nitrogenous substances) calculated from above mentioned salts or substances.

These mixtures are made slightly alkaline by potassium carbonate.

Any grain, such as rice corn wheat, barley &c., or substances which supply the necessary ingredients for the growth of the fungi such as slop (solid portion) from 40 alcoholic distillation, pressed slop (solid portion) from beer breweries; any bran crash or other fabric saturated with the above mentioned slop or other substances which supply the necessary ingredients for the growth of the fungi may be used for cultivating the mould fungi above mentioned, but the proportions of the ingredients in the above formula may be varied somewhat, depending upon the particular grain 45 or other substance used. The several grains, such as rice, corn, wheat, barley, *etc.*, and other substances, such as (solid portion) slop, bran, crash or other fabric, saturated with slop, *etc.*, have been analysed and their chemical constituents are known and the variations in the proportion of the above formula should be made to supply a particular grain or other substance with any of the several chemical 50 elements in which it is more or less deficient. For rice the first column of figures in the above formula set out, represents the proper proportions. Corn requires a greater proportion of phosphoric acid and ammonium salts or nitrogenous substances. The same grains may vary somewhat and the most useful and successful results 55 depend upon the experience and observation of the operator and chemist in determining the proportions. I do not limit myself to the exact ingredients mentioned, as there are other elements which may be regarded as the chemical



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equivalents of the ingredients named, and which may perform suitably the same functions in connection with the other ingredients; such as sodium salts or lithium salts may be substituted for potassium salts, and barium and strontium salts may be used instead of calcium salts, *etc.*, *etc.* These ingredients may be dissolved in  
 5 water and sprayed over the cereals, or other substances named above, uniformly, or the cereals (either before or after being steamed) may be plunged into the solution made to a proper strength; or these ingredients may be mixed with inert substances, such as starch, *etc.*, so as to increase the volume and sprinkled uniformly over, and well mixed with, the cereals and other substances used.

10 After the cereals, *etc.*, have been impregnated with these mixtures and steamed until the starch cells are open, or until the whole mass is thoroughly sterilized (if not previously steamed sufficiently) the mass is cooled down to the temperature of 20° to 30° C., when about one fifty-thousandth part, in weight, of the cereals or other substances used, of the matured seed Mycelial fungi is added and well mixed  
 15 therewith. The mass is bedded up and allowed to remain for about six hours, when the same quantity of matured seed is added and thoroughly mixed again. After about eighteen hours more or less, the mass is divided into small portions and allowed to remain about five hours longer, when it is spread out in thin layers in a room where the temperature ranges from 20° to 30° C., and a proper degree of  
 20 humidity and fresh supply of air is secured. At the expiration of from three to six days the mass will be found to be covered with the fully matured fungus. It is then taken out of the growing room, and is ready for immediate use.

Or the mass may be dried and the matured seed may be separated from the cereals or other substances on which it is grown, and preserved in air tight vessels.  
 25 By this means a better and more uniformly matured seed of the fungi is obtained than by the old method used in making Tane'-Koji or Moyashi.

The mass thus obtained by the above described process has a mouldy appearance and will be of a color depending largely upon the cereals or other substances on which it was grown, and, also, upon the fungus employed. This matured fungus  
 30 when sown on suitable nourishing substances and developed to a certain stage acquires diastic or fermenting properties, or both, and for these properties they are valuable for use in the art of alcoholic fermentation and kindred industries.

Taka-Moyashi is dried, either by desiccating substances, such as strong sulphuric acid, or anhydrous calcium chloride, in the usual desiccating process at a tempera-  
 35 ture below 15° C., or by passing a current of dried air, below 20° C., through it. Then it is sifted through a fine sieve and the grains or other substances on which it is grown, separated from the matured seed Mycelial fungi, which is "pure Taka Moyashi" in the form of a fine powder. The powder thus prepared is again dried by the above process, and is then sealed in air tight vessels, or, it is mixed with inert  
 40 substances such as starch, or inert and at the same time hygroscopic substances, such as roasted starch or anhydrous calcium sulphate.

The objects in mixing these ingredients are two fold; (1) To increase the volume so as to be convenient for sprinkling the cereals or other substances in Koji making. (2) To keep the matured seed Mycelial fungi dry, to prevent any  
 45 possibility of a change from a dormant state to a state of activity; or the powder when kept in sealed vessels may be surrounded by the above mentioned hygroscopic substances to prevent any possibility of absorbing moisture.

The matured seed in the mass thus prepared I call generically "Taka-Moyashi" to distinguish it from the ordinary Moyashi or Tane'-Koji, and when separated  
 50 from the mass I call it generically "pure Taka Moyashi."

I now proceed to describe my process of preparing and developing and making Taka Koji.

In the old process of Koji making, rice is steeped in water and steamed until the starch cells are opened, when it is cooled down to a temperature of about 30° C.,  
 55 and about one two-thousandth part, in weight, of the rice employed, of the Tane'-Koji is added and thoroughly mixed with the steamed rice. The mass is bedded



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up and allowed to remain for about six hours when the same amount of Tane'-Koji or Moyashi is added as before. At the expiration of about twenty hours, the mass is divided into small portions and placed in trays and kept under proper manipulation, temperature and humidity until the fungus growth is sufficiently matured; it is then taken out of the growing room and kept in a cool place ready for use.

Koji thus prepared has an opaque white mouldy appearance, and possesses diastatic properties and contains ferment cells.

The defects of the old process of making Koji, which I remedy by my invention are as follows; viz.:—

1st. The grains used in making Koji in the alcoholic industries have been limited to rice alone, although this term Koji has been applied to wheat and beans prepared as an article of food.

2nd. The whole unbroken grains are employed.

3rd. The only fungus used is the particular species *Aspergillus Koji*, 15  
Takamine;

4th. The making of the Koji is completed when the fungus growth is sufficiently advanced and the shed Koji consisting of the fungus and the substance on which it was grown is used in the mass in this finished condition, both as a diastase for the conversion of starch into sugar, and, also, as a ferment 20 in changing the sugars into alcohol. As a consequence when the conversion is carried on under a high temperature, the ferment cells are killed and wasted; and, on the other hand, in the press of fermentation, the diastatic properties of the Koji are of no value, and are all wasted. The finished Koji thus described is kept in small trays in thin layers for preservation; and its preservation in bulk or 25 in large masses is impossible owing to the fact that the moisture it contains generates heat, causing the decay of the product.

In my process of making Taka-Koji, I do not limit myself to the above named cereals, but employ in addition to these corn, oats, barley, and all other cereals and, also, other substances which supply the ingredients necessary to the growth of the 30 fungi, such as pressed slop (solid portion of) from alcoholic distillations, grain from beer brewing; the residue from seed oil, beet root sugar, glucose and starch factories, and other artificial mixtures such as bran, crash or other fabric, saturated with any of the above slops or thin paste of gelatinized starch obtained from corn wheat or other cereals or starch containing or nutritious substances. I secure by 35 this process cheaper and more efficient substances in which to grow fungi for diastatic and fermenting purposes.

The cereals and other substances employed are broken and comminuted, whereby the surface on which the fungi grow is largely increased, and consequently a more abundant growth of the fungi is secured, and the diastatic and fermenting properties 40 of the Taka-Koji are of superior strength and are produced more economically.

I use such species of *Aspergillus* (including *Aspergillus Koji*), *Mucor*, *Oryzae* and *Penicillium* and other fungi as produce diastase and ferment cells or either of these products alone.

In my process Taka-Koji may be used in a condition corresponding to the 45 condition in which Koji is used as above described, both as a diastase and a ferment at the same time; or, after the fungi are sufficiently grown the mass consisting of the fungi and the substance on which they were grown may be thoroughly dried and the fungi containing the ferment cells separated by sifting washing or otherwise from the cereals or other substances employed, which cereals or other substances 50 employed contain the diastatic properties of the Taka-Koji. The two parts, the one containing the ferment, and the other the cereals or other substances, containing the diastatic properties of the Taka-Koji may be used separately, the part containing the diastase for converting the starch into sugar; and the part containing the ferment cells for the fermentation or changing the sugar into alcohol. By means 55 of this division and separation I utilize fully, without any waste both the diastatic



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and fermenting properties of the Taka-Koji and employ but about one-half the quantity of Taka-Koji with better results in conversion and fermentation, than is required where Koji is employed in an unseparated condition as above described.

Taka-Koji is dried by artificial means whereby it can be preserved for an indefinite period in bulk and without spreading into thin layers, securing by this means great economy of space and materials.

The cereals and other substances containing the necessary ingredients for the growth of the fungi are employed in a broken or comminuted form in order to increase the surface on which the fungi grow to their highest state of efficiency.

10 The cereals or other substances are steamed, or heated, in the case of cereals until the starch cells are opened, and in the case of the other substances until they are thoroughly (if not already) sterilized. The cereals employed in making Taka-Koji are corn, rice, wheat, barley, oats and any other cereals supplying the necessary ingredients for the growth of the fungi; and the other substances employed are

15 pressed slop (solids) from alcoholic distillations—slop or grain (solids) from beer brewing, refuse and waste from glucose, starch, beet root sugar and seed oil factories, or any bran, crash or other fabric, saturated with any of the above mentioned slop (liquid or solid or both combined) or nutritious substances, such as thin paste of gelatinized starch obtained from corn wheat or other cereals

20 or starch containing substances and all other substances whether in their natural state or artificially treated which possess the necessary ingredients for the growth of the fungi.

After being thoroughly steamed as before described the mass is allowed to cool down to a temperature below 30° C., when about one fifty-thousandth part in

25 weight of the cereals or other substances employed, of the pure Taka-Moyashi, or about one one-thousandth part, in weight, of the mass of cereals or other substances employed, of the Taka-Moyashi, or Tane'-Koji is added to and thoroughly mixed with the mass of cereals or other substances employed, and the entire mass of cereals or other substances is then bedded up and allowed to remain in a temperature not exceeding 40° C., for six hours, when with or without the addition of

30 more Taka-Moyashi, or Tane'-Koji, the mass is again mixed and bedded up. At the expiration of about eighteen hours, the mass is divided into small portions and allowed to remain for about five hours longer, when it is spread into thin layers, by suitable arrangements or apparatus and kept in a moist atmosphere under a temperature not to exceed 50° C., for a period varying from 20 to 60 hours. When

35 the highest point of utility of the Taka-Koji as a diastase and ferment is attained (indicated by the appearance of the fungus growth) the mass is cooled down to a temperature not exceeding 20° C. The mass thus obtained is Taka-Koji made by my process and is ready for immediate use.

40 Or the mass after Taka-Moyashi or Tane'-Koji, (or Moyashi) has been added and bedded up for from ten to eighteen hours may be spread out on a preferably cemented floor, such as is now used for growing and developing malt and thinned out gradually by turning and spreading every two to four hours as the temperature rises, until it reaches a thickness of from two to four inches. During a process of

45 spreading and thinning out which is continued for from twenty to sixty hours, care must be taken that the temperature of the mass does not rise much above 40° C., and, also, that the air of the room be kept sufficiently moist. At the expiration of about sixty hours, the fungus growth will be found to be sufficiently developed for the purpose for which the Taka-Koji is made and it will be ready for

50 immediate use.

Taka-Koji presents in this form a mouldy appearance its color depending largely on the cereals and other substances used, and, also, on the species of the fungi employed. It possesses both diastatic and fermenting properties or either of these properties alone, the diastatic properties residing in the cereals or other substance employed and the fermenting properties are due to ferment cells

55 grown on the fungus plant. When the diastatic and fermenting properties are



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both profitably utilized at the same time, the Taka-Koji may be used in its condition as described.

For the preservation solely of Taka-Koji it is thoroughly dried under a temperature not exceeding 50° C. and kept in a mass in a dry place at a temperature not exceeding 50° C.

Where Taka-Koji is used for conversions made at a temperature exceeding 60° C., or where the fermenting power alone of the Taka-Koji is utilized, the dry Taka-Koji is separated either by sifting through a sieve or otherwise into two parts,—one containing in the form of a fine dry powder the fungus or ferment cells, containing the fermenting properties and the other part, the cereals or other substances employed, which contain the diastatic properties of the Taka-Koji; these two resulting products, the one the seed of fungus or ferment cells, the other the diastase containing substances, are used separately and independently of each other; the seed of the fungus or the ferment cells for the purposes of fermentation and the diastase containing substance for purposes of converting starch into sugars. Or the diastatic and fermenting properties of the Taka-Koji may be separated from the substance on which it grows by soaking the Taka-Koji in water and stirring and pressing, whereby the diastase will dissolve in the water and the ferment cells will become detached and remain suspended in the liquid. This process of steeping in water and pressing is repeated as often as required. The liquid thus produced will contain the diastase of the Taka-Koji in solution and the ferment cells held in suspension. These are separated the one from the other by filtration.

When the separation of the diastatic properties of the Taka-Koji alone is desired, the Taka-Koji is steeped in water and pressed through a filter, the clear solution thus obtained contains the diastase alone.

I now describe my process of preparing developing and making Moto.

The term Moto is applied to a liquor containing active ferment cells which have been metamorphized from aerobiotic ferment cells grown on the Mycelial fungi (Koji or Taka-Koji) to anaerobiotic ferment cells, and by the process of germination, have developed and multiplied into an active state in sugar solution. Moto corresponds to the article known as yeast in its use in the arts, such as alcoholic fermentation, bread making &c., etc.

In the old process of making Moto, six parts of clean steamed rice, with two and one-half parts of rice-koji, and seven and one-half parts of water are mixed together, and the mixture exposed to the air with occasional stirrings at the natural winter temperature varying from 0 to 15° C. for five or six days; during this time granulation of the grain and absorption of oxygen from the air takes place. After this period the temperature of the mixture is raised by placing in it a tub containing water heated to nearly the boiling point and it is kept at a temperature varying from 15° to 30° C. for from four to six days. During the early part of this state, conversion of the starch into sugars begins and proceeds increasingly, and the multiplication of the ferment cells, and alcoholic fermentation goes on at the same time; at the latter end of this period the taste of sugar disappears and the taste of alcohol takes its place, when the Moto is considered to be finished and ready for use.

The defects of the old process as described, are :—

1st. The only substance known which could supply the necessary ingredients for any practical growth of the ferment cells was rice, and no process or treatment was known by which other, natural or artificial, substances containing such necessary ingredients, could be employed.

2nd. The conversion of the starch into sugars by the diastase contained in the Koji being made at a low temperature a complete conversion is not attained; in some instances as much as 16% of the finished Moto, consisting of unconverted starch. The presence of this unconverted starch caused acid fermentation, both in the Moto and in the subsequent fermentation of the mash.



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3rd. The temperature of the mixture is not uniform or regular, by reason of the crude and imperfect method employed in heating it; consequently the development of the ferment cells is irregular and imperfect, and the Moto is from this cause, also, subject to injurious fermentation.

5 4th. The entire process being very slow, the Moto is exposed for a great length of time to injurious bacteria in the surrounding air.

5th. The grain of the rice and of the Koji is employed in an unbroken state and the only means of crushing the grains being the stirrings to which the mixture is subjected, much of the starch in the grains is not released and remains from this  
10 cause unconverted into sugars; resulting not only in a waste of material, but in an injury to the quality of the Moto.

In my process of making Moto, any of the cereals or starch containing substances or substances which supply the necessary ingredients for the growth of the ferment cells, may be employed. These cereals or starch containing substances, *etc.*, are  
15 first ground to a fine meal, to which about twice their own weight of water is added and in which they are thoroughly cooked, preferably at about a temperature of 150° C. under pressure, so that all the starch cells are opened and gelatinized; it is then cooled down to a temperature of from 60 to 75° C. To this mass is added from 3 to 20% in weight of the cereals or other substances used, of  
20 Taka-Koji, either ground or unground, or of the diastatic portion of the Taka-Koji alone, either in a solid or a liquid form, or of ordinary Koji, either ground or unground, and well stirred and kept at the above temperature for about one hour, during which period the thorough and complete conversion of the starch in the mass into sugars is made. It is then allowed to cool down slowly being constantly  
25 agitated by stirring whereby the solution or mash absorbs the proper amount of oxygen from the air, the stirring continues until the temperature is reduced to about 19° C., at the expiration of from 5 to 20 hours there is added to the solution or mash about the same amount that was used before of the Taka-Koji, either ground or unground, or of the ferment portion alone of the Taka-Koji, either in  
30 solid or liquid form or of Koji. The solution or mash is then allowed to remain while the development and multiplication of the ferment cells, and the process of fermentation goes on, care being taken to keep the temperature of the solution or mass at this time below about 30° C.—which is conveniently accomplished by the use of a tub fitted inside with a coil through which hot and cold water can be  
35 passed at will. When the maximum point in the development and multiplication of the ferment cells is reached, which is generally indicated by the change in the taste of the solution or mash from a sweet to an alcoholic flavor, the solution or mass is preferably cooled down to a temperature of from 15 to 20° C., and the Moto as made by my process is ready for use.

40 The ferment cells contained in Moto are developed and multiplied in a sugar solution from the Taka-Koji or from the ferment portion of the Taka-Koji. This sugar solution may be produced by the conversion of gelatinized starch into sugars by means of the diastase of the Taka-Koji, or of malt; or it may be any other sugar solution or, furthermore, it may consist of any mixture containing the  
45 necessary ingredients for the development and multiplication of the ferment cells.

Moto, as made by my process, may be perpetuated or reproduced by transplanting Moto previously made as above described to any sugar solution, made as above described, or to any solution containing the ingredients necessary for the development of and multiplication of the ferment cells.

50 The Moto prepared by my process requires the employment of a much less quantity of grain; it is produced in much less time and with greater certainty as to results; it contains about three times greater a number of ferment cells to a given weight, and the fermenting power of the ferment cells is increased. The Moto is consequently more efficient and active as a ferment and it can be preserved and  
55 utilized much longer than Moto made by the old process.

I shall now proceed to describe my process of fermenting alcoholic liquors:

In the production of alcoholic liquors from cereals or other starch-containing



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substances, by any known process, the first step is the conversion of the starch in the cereals &c., into soluble sugars by means of an agent known as diastase. The second and remaining step in the process of producing fermented alcoholic liquors is the dissociation of the soluble sugar into alcohol and carbonic acid gas by the agency of the ferment cells.

In the pursuit of alcoholic industries in the American and European countries, the conversion of starch contained in the cereals and other substances employed, into sugars, is effected by means of the diastase contained in the malts. Diastase obtained from malt is very expensive, not only because it is made from the highest priced grain and because of the cost and labour of malting them, but, also, by reason of the great loss of starch in the grain, which occurs in the malting process and diminishes the yield of alcohol. The change of the sugar thus obtained, into alcohol, is effected by means of Vini-yeast (*Saccharomyces Cerevisiae*) which is incapable of developing and multiplying in solution containing more than six or seven per cent. of alcohol and, is therefore unable to ferment a liquor of more than six or seven per cent. of alcoholic strength.

In the pursuit of alcoholic industries in other countries of the world (Oriental) the conversion of starch contained in the grain employed is effected by means of a diastase produced by the growth of a species of mould fungi (*Aspergillus-Koji* "Takamine") on rice. As this conversion is made at a low temperature, a complete change of the starch into sugars is impossible and a great length of time is required exposing the solution to danger from injurious ferments in the surrounding air.

The process of fermentation is effected by the agency of aerobic ferment cells, grown on the above fungus and metamorphized into anaerobic ferment cells, which change the sugars in the solution into alcohol. The above mentioned conversion and fermentation being carried on at the same time, or simultaneously, the process of fermentation is slow and occupies a great length of time, which also subjects the solution to danger from injurious ferments in the surrounding air; the incomplete conversion above mentioned of the starch into sugars not only results in the waste of material, but causes acetic fermentation, which consumes the alcohol produced and diminishes the yield.

In my process of making fermented alcoholic liquors I employ any of the cereals or starch containing ingredients or substances which supply the necessary ingredients for the alcoholic fermentation. These cereals or starch containing substances *etc.*, are first ground to a fine meal which is thoroughly cooked with from one half to five times the weight of cereals &c., of water, preferably at a temperature of 155° C. under pressure so that all the starch cells are open and gelatinized. The mass is then cooled down to a temperature of from 65° to 70° C.

To this mass of cereals or other substances used thus cooked is added 3 to 20 % in weight of Taka-Koji, either ground or unground, or of the diastatic portion of the Taka-Koji alone either solid or liquid in form, or of the ordinary Koji, either ground or unground, and well stirred, and kept at the above temperature for about one hour, during which period the thorough and complete conversion of the starch contained in the cereals and other substances used into sugars is made. It is then cooled down to about 19° C.

The sugar solution thus prepared is of such strength or composition that the sugars contained in it when converted into alcohol produce the desired strength of alcohol.

To the sugar solution thus obtained or to any other sugar solution obtained in any other way, such as glucose solution, malt extract, inverted cane sugar solution; syrup or molasses solution *etc.*, from 2 to 10 % of Moto or a mixture of Moto and yeast or yeast is added, and the process of fermentation or the dissociation of the sugars contained in the solution into alcohol and carbonic acid gas by the agency of the ferment cells contained in the Moto, or mixture of Moto and yeast, goes on until all the sugars in the solution are dissociated.

As the process of fermentation goes on any other sugars or sugar solution may be added to the mash all at once or fractionally. The object of adding the



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fermentable sugars fractionally is to keep the mash in a suitable strength of sugars so that the fermentation is not retarded by the presence of too much sugar in the mash at one time.

Usual and due precaution is exercised during the process of fermentation.

5 The time required to complete fermentation depends largely upon the strength of the sugar solution. Where the solution is of the same or equal strength as the solution in which yeast alone is employed, the fermentation is much superior and occupies less time, owing to the superior character of the ferment cells contained in the Moto.

10 The percentage of alcohol contained in the fermented liquor produced by the fermentation, is proportionate to the strength of the sugar solution or sugars used.

Alcoholic liquors fermented by ordinary yeast contain from but six to seven *per cent.* of alcohol, owing to the inability of the yeast cells to live and work in a solution containing more than six or seven *per cent.* of alcohol; therefore in order to  
15 obtain six or seven parts of alcohol, one hundred parts of the fermented liquor have to be dealt with throughout the entire process.

By my process a fermented liquor containing about 20% of alcohol is made, owing to the ability of the ferment cells in the Moto increased in ferment power and number by my process of preparing it, to live and work in a solution containing  
20 20% of alcohol when fermented; or a fermented liquor containing any desired strength of alcohol under 20% can be produced; therefore in order to get the same quantity of alcohol, as before, I have to deal with only about one-third part of the liquor. Thus the cost of labour and fuel, the amount of capital and the size of the plant are reduced to one third or thereabouts or a given sized plant can  
25 produce three times as much alcohol as by the old process where yeast is employed, with the same or nearly the same working expenses.

If the object of the fermentation is for strong or distilled alcoholic liquors, such as whiskey, rum, gin, *etc.*, the fermented liquor is subjected to the process of distillation. When the fermentation is for weaker beverages, such as beer, ale,  
30 porter *etc.*, the fermented liquor is previously treated to suit its respective object, such as boiling with hops, or scorching of grain and afterwards diluting with water to its desired alcoholic strength, and then charged with air or carbonic acid gas if required.

Having now particularly described and ascertained the nature of my said  
35 invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. The process of growing, preparing and developing a fungus possessing diastatic and fermenting properties or either of said properties which consists (1) in impregnating or saturating the natural grain or other substances employed with an  
40 artificial supply of proper food for the growth of the fungus, composed as follows:—

1. Ammonium salts, such as ammonium tartarate or ammonium acetate, or nitrogenous substances such as albumen or gelatine;
2. Potassium salts, preferably potassium sulphate or potassium phosphate;
- 45 3. Magnesium salts, preferably magnesium sulphate;
4. Calcium salts, preferably calcium sulphate or calcium phosphate;
5. Phosphates, preferably calcium or potassium phosphates;
6. Alkaline carbonate, preferably potassium carbonate;

in the proportions specified; (2) Steaming said rice or other substances either  
50 before or after the impregnation or saturation as above; (3) Sowing or planting the seed of said fungus upon the grain or other substances thus impregnated or saturated; (4) Subjecting said mass thus prepared and treated to a proper and even temperature and to manipulation for the growth and development of the fungus until the same has reached its maturity; substantially as and for the  
55 purpose set forth.

2. The process of preserving the matured seed of a fungus possessing diastatic and



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fermenting properties or either of said properties, which consists in thoroughly drying the mass (Taka-Moyashi); separating the matured seed therefrom by any means, such as sifting, again drying the seed; mixing said seed with an inert or with an inert and hygroscopic substance and sealing in air tight vessels; substantially as and for the purpose set forth.

3. As an article of commerce, the seed of a fungus possessing the properties of producing diastase and fermenting properties or either of said properties, when sown on suitable nourishing substances in the form of a dry yellowish green powder containing dormant vital ferment cells, substantially as and for the purpose set forth.

4. As an article of commerce, Taka-Moyashi in the form of a mass of comminuted grain or other substance that has been impregnated or saturated with:

1. Ammonium salts, such as ammonium tartarate ammonium acetate or nitrogenous substances such as albumen or gelatine;
2. Potassium salts, preferably potassium sulphate or potassium phosphate;
3. Magnesium salts, preferably magnesium sulphate;
4. Calcium salts, preferably calcium sulphate or calcium phosphate;
5. Phosphates, preferably calcium or potassium phosphates;
6. Alkaline carbonate, preferably potassium carbonate, in the proportions specified and which is thoroughly permeated with a growth of the matured fungus containing diastase and fermenting properties, or either of said properties; substantially as and for the purpose set forth.

5. The herein described composition of matter to be used for fertilizing the cereals and other substances, upon which Mycelial Fungi (Mould Fungi or Hyphomycetes Fungi) having the properties of producing diastase and ferment cells, or either of these properties alone, is grown and developed, consisting of:

1. Ammonium salts, such as ammonium tartarate ammonium acetate, or nitrogenous substances such as albumen or gelatine;
2. Potassium salts, preferably potassium sulphate or potassium phosphate;
3. Magnesium salts, preferably magnesium sulphate;
4. Calcium salts, preferably calcium sulphate or calcium phosphate;
5. Phosphates, preferably calcium or potassium phosphates;
6. Alkaline carbonate, preferably potassium carbonate; in substantially the proportions specified.

6. The process of preparing and making Taka-Koji which consists in providing a mass of broken and comminuted grain or starch containing substances, or substances possessing the necessary ingredients for the growth of the fungus; steaming and heating the mass until the starchy matter present is gelatinized or the mass sterilized (unless the material employed in the mass has been previously sterilized) adding to the mass in proportion to the weight about one fifty-thousandth part in weight of the pure Taka-Moyashi or one thousandth part of the Taka-Moyashi or Tane-Koji, mixing the same thoroughly and subjecting the mass to the temperature and manipulations until the fungus properly develops and is cooled; substantially as shown.

7. The process of preparing and making Taka-Koji which consists in providing a mass of broken and comminuted grain, or starch-containing substances, and substances possessing the necessary ingredients for the growth of the fungus; steaming and heating the mass until the starchy matter present has been gelatinized and the mass sterilized; adding to the mass in proportion to its weight about one fifty-thousandth part in weight of pure Taka-Moyashi, or one one-thousandth part in weight of Taka-Moyashi or Tane-Koji, thoroughly mixing the entire mass and bedding up the same in a temperature not exceeding 40° C., after six hours again thoroughly mixing and bedding up the mass; at the expiration of about ten to eighteen hours, during which the temperature should not be permitted to rise above 40° C., which is done by frequent turnings of the mass; dividing the mass into small portions in which condition it remains for about five hours when it is



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spread out into thin layers in a temperature not to exceed  $40^{\circ}\text{C}$ ., for from 20 to 60 hours, until the fungus develops to a proper stage, then cooling down the mass to a temperature not exceeding  $20^{\circ}\text{C}$ ., all substantially as shewn.

8. The process of preparing and making Taka-Koji which consists in providing  
 5 a mass of broken and comminuted grain or starch-containing substances or substances containing the necessary ingredients for the growth of the fungus, steaming and heating the mass until the starchy matter present is gelatinized and the mass sterilized; adding to the mass in proportion to its weight about one fifty-thousandth part in weight of pure Taka-Moyashi or one one-thousandth part in  
 10 weight of Taka-Moyashi or Tane'-Koji, thoroughly mixing the entire mass and bedding up the same in a temperature not exceeding  $40^{\circ}\text{C}$ ., after six hours again thoroughly mixing and bedding up the mass; at the expiration of about 10 to eighteen hours spreading the mass on a preferably cemented floor such as is used in growing malt turning the mass over every two to four hours and gradually thinning  
 15 it out until it reaches a thickness of about two to four inches, taking care not to permit the temperature of the mass to rise above  $40^{\circ}\text{C}$ ., and continuing this turning and thinning for from 20 to 60 hours until the fungus grows to a proper stage, all substantially as described.

9. The process of preparing and making Taka-Koji which consists in providing  
 20 a mass of broken and comminuted grain or starch-containing substances, or substances possessing the necessary ingredients for the growth of the fungus; steaming and heating the mass until the starchy matter present is gelatinized and the mass sterilized (unless the material employed in the mass has been previously gelatinized or sterilized) adding to the mass in proportion to its weight  
 25 about one fifty-thousandth part in weight of pure Taka-Moyashi, or one one-thousandth part in weight of Taka-Moyashi or Tane'-Koji, thoroughly mixing the entire mass, and subjecting it to the temperatures and manipulations until the fungus develops to its proper stage and is cooled down; then separating the seed or ferment cells of the fungus from the mass, or separating the ferment cells and  
 30 diastase from the mass together, or separating the diastase and ferment cells from each other by filtration all substantially as shewn.

10. As an article of commerce Taka-Koji consisting of a mass of broken and comminuted grain or starchy matter or other substances possessing the necessary ingredients for the growth of the fungus having diastatic or fermenting properties or  
 35 both of these properties; the starchy matter if any present gelatinized and the mass sterilized; said mass being covered and permeated with the growth of said fungus or fungi growing upon and adhering to the surfaces of the comminuted particles of said mass; all substantially as shown.

11. As an article of commerce Taka-Koji consisting of a mass of broken and  
 40 comminuted grain or starchy matter or other substances possessing the necessary ingredients for the growth of a fungus having diastatic or ferment properties, or both of said properties; the starchy matter, if any present, gelatinized and the mass sterilized; said mass being permeated with the diastase from the growth of the fungus the seeds thereof being removed therefrom all substantially as shown.

4. 12. As an article of commerce, Taka-Koji a fine dry powder composed of the seeds or spores possessing fermenting power of fungi possessing diastatic or fermenting properties or both of said properties, being the product of said fungi grown upon cereals starchy matter or other substances possessing the necessary ingredients for their growth; all substantially as described.

50 13. The process of preparing and making Moto which consists in adding to and mixing with any fermentable solution in the proportion of one hundred parts of sugar and twenty parts of Taka-Koji or five parts of the ferment portion of Taka-Koji and keeping the same at a temperature below  $30^{\circ}\text{C}$ ., until the fermentation has changed the flavor of the mixture to an alcoholic taste and the development  
 55 and multiplication of the ferment cells have been effected all substantially as described.

14. The process of preparing and making Moto which consists in (1) adding to



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a mash of cereals, starch containing substances, or other substances capable of conversion into sugars, cooked in about twice their own weight of water under pressure until the starch cells are opened and gelatinized and then cooled down to about from 60° or 70° C. from five *per centum* to 20 *per centum* in weight of the cereals &c., of Taka-Koji either ground or unground, or of the diastatic portion of the Taka-Koji alone either in a solid or liquid state, or of the ordinary Koji, ground or unground, and then thoroughly stirring the same for about one hour and until there is a thorough and complete conversion of starch into sugars; (2) continuing the agitation by stirring until the temperature of the mass is reduced to about 19° C., then adding thereto about the same proportion of Taka-Koji or ordinary Koji, ground or unground, or of the ferment portion of the Taka-Koji in solid or liquid state, that was previously added, then allowing the mass to stand at a proper temperature until the flavor of the mass acquired an alcoholic taste and the development and multiplication of the ferment cells are effected; all substantially as described.

15. The process of preparing and making Moto which consists in (1) treating a mash of ground cereals starch containing materials or other substances capable of conversion into sugars, cooked until the matter capable of being converted into sugars has been gelatinized adding to the mass at a temperature of from 65 to 70° C., from five to twenty *per centum* in weight of the cooked mass, of Taka-Koji, ground or unground; or of the diastatic portion of the Taka-Koji in a solid or liquid state, or of ordinary Koji ground or unground; then stirring the mass for about one hour and until there is a thorough conversion of the starchy matter present into sugars (2) continuing the agitation by stirring until the temperature is reduced to about 19° C., then again adding about the same proportion of Taka-Koji, or Koji ground or unground, in a solid or liquid form that was first added; then allowing the mass to stand at a proper temperature until the fermentation gives the mass an alcoholic flavor and the development and multiplication of the ferment cells are effected; all substantially as described.

16. As an article of commerce, Moto—a liquid or thin paste composed principally of water and alcohol with some slight residuum or traces of gelatinized starch sugars and fibre, and containing fully and uniformly throughout its mass the active ferment cells possessing ferment properties or both ferment and diastatic properties, all substantially as described.

17. As an article of commerce, Moto, a liquid or thin paste composed principally of water and alcohol with some slight residuum or traces of gelatinized starch sugars and fibre; and containing throughout its mass the active ferment cells first grown on aerobiotic fungi and other substances containing the required nutriment, and, secondly, developed and multiplied as anaerobiotic ferment cells in sugar solutions; all substantially as described.

18. The process of making a fermentable wash or liquor which consists in adding to the mass or material to be converted in the proportions specified, the diastatic portion of the Taka-Koji or of the ordinary Koji, at the temperature specified and agitating the same, whereby the convertible material present is converted into sugar, substantially as described.

19. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor by adding thereto in the proportions specified, Moto or Moto and yeast, or yeast whereby the fermentable material present is dissociated into alcohol and gas; all substantially as described.

20. The process of making a fermented liquor which consists in adding a fermentable wash or liquor prepared by the introduction in the proportions specified of Taka-Koji or the diastatic portion of the Taka-Koji or of Koji to a ferment containing wash or liquor prepared by the introduction in the proportions specified of Moto or Moto and yeast, or yeast said addition being made fractionally as the fermentation proceeds in order to keep the solution at the desired strength, whereby the fermentable material present is dissociated into alcohol and gas; all substantially as described.



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21. The process of making alcoholic liquor which consists in fermenting a fermentable wash or liquor by the introduction of Moto or Moto and yeast or yeast in the proportions specified and distilling the product; all substantially as described.

- 5 22. The process of making a fermented liquor which consists in adding a fermentable wash or liquor prepared by the introduction in the proportions specified of Taka-Koji or of the diastic portion of the Taka-Koji or of Tane'-Koji, to a ferment containing wash or liquor prepared by the introduction in the proportions specified of Moto or Moto and yeast or yeast said addition being made fractionally  
10 as the fermentation proceeds in order to keep the solution at the desired strength whereby the fermentable material present is dissociated into alcohol and gas, and distilling the products; all substantially as described.

23. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor that has been treated by the introduction of hops,  
15 scorched grain or similar material by adding thereto in the proportions specified Moto or Moto and yeast or yeast and then diluting the same to the required alcoholic strength; all substantially as described.

Dated this 12th day of October 1891.

JOKICHI TAKAMINE,

By L. W., per F. B.

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